SOME NOTES ON MYRIOPHYLLUM SPICATUM

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In the distant past it was generally assumed that the majority of species of higher plants of the boreal zone had a circumpolar distribution, perhaps somewhat interrupted in climatically adverse regions. Many species originally described from northern Europe were found to be represented also in America and eastern Asia. Although some students did observe a few differences between these populations, others minimized this, and the general hypothesis of circumpolar distribution of most of these plants was regarded as an indisputable fact despite the limited evidence.

When larger collections were accumulated from different parts of the globe and critical botanists started to make detailed studies of the circumpolar species, several of these were found to be composed of morphologically distinct taxa each of which was characterized by its more or less defined area. In case such taxa are only races of the same species, classifiable at the subspecific level or lower, their combined area is that of a truly circumpolar species. However, many are doubtlessly better regarded as species, and it is then a fallacy to classify them only as a part of a circumpolar species. Such a grouping may be very misleading from all geobotanical points of view because it indicates identity of units that are evolutionarily dissimilar, or could at least be expected to be so. In many cases such taxa are known to differ not only in morphology and distribution but also in chromosome number, so they cannot logically be interfertile races but must be regarded as evolutionarily distinct species on basis of their strong reproductive isolation. This was pointed out recently by Löve (1954a, b, 1955) in connection with studies of some such taxa from Eurasia and North America. Collectively speaking, these taxa appear circumpolar, but from the point of view of modern evolutionary taxonomy and geobotany they are only quasi-circumpolar, because each such collective taxon is composed of two or more false vicariants that are true species of a more limited range and often of a different origin.

One of the species that is still regarded as circumpolar by many is the aquatic *Myriophyllum spicatum s. lat.*, originally described by Linnaeus (1753) from quiet waters in Europe, with references to localities from Lappland in the north to Montpellier in the south. A North American plant was identified as the same species by Pursh (1814) and these two were regarded as being completely conspecific until Fernald (1919) pointed out that they differ in several characters so essential that he did not hesitate to give the American plant a new name, *M. exalbescens*. Although Fernald (l. c.) clearly showed that each of the two taxa has a wide and distinct geographical range, in addition to their morphological differences, later authors have often either ignored *M. exalbescens* (Rydberg, 1932; Tidestrom & Kittel, 1941) or agreed with Hultén (1947) in regarding it as only an American subspecies *exalbescens*, of the circumpolar species *M. spicatum*.

Only a few chromosome numbers have so far been reported for species of the genus *Myriophyllum*. The first report, 2n=14, was made by Scheerer (1939) on German populations of *M. alterniflorum* L., and this has later been confirmed for Icelandic and American material by Löve & Löve (1956, 1958) and for Greenland plants by Jörgensen, Sörensen & Westergaard (1958). Scheerer (1940) also reported the number 2n=28 for German plants of *M. verticillatum* L., whereas Japanese plants so named have 2n=42, according to Harada (1952). *M. tenellum* Bigel. is diploid with 2n=14 chromosomes, as determined by the present writer on material from Lac Ouareau in the Laurentian Mountains of Quebec. Reports of the chromosome number of *M. spicatum* L. *s. str.* first were made by Löve & Löve (1948), who then had counted 2n=c. 36 in an inferior fixation of Icelandic material, whereas later Löve (1954a, b) corrected this to 2n=28 also on the basis of faulty preparations from plants of two Icelandic localities. Recently better fixed material from Mývatn in northern Iceland has been found to have 2n=42 chromosomes so the plant is apparently a hexaploid.

In connection with the corrected report of 2n=28 chromosomes for *M. spicatum*, Löve (l. c.) reported that *M. exalbe-*

scens is a diploid with 2n=14 chromosomes, as had been counted on material from Lake Manitoba. Consequently, since this indicated that these two related taxa were not only morphologically and geographically distinct as shown by Fernald (l. c.) but also separated by a reproductive barrier as indicated by the difference in chromosome number, it was concluded that this added considerable strength to the separation of these taxa at the specific level. Unfortunately, however, this report has later been found to be erroneous due to a mixup of notes; the material in question belonged to *M. alterniflorum* L. Specimens of true *M. exalbescens*, from Lake Manitoba and its marshes at Delta on its southern shores (cf. Löve & Löve, 1954), were found to have 2n=42 chromosomes. That number has later been confirmed on plants from several places in the Rocky Mountains of British Columbia and Alberta, several lakes in different parts of Manitoba where material was fixed by the present writer or by Dr. J. C. Ritchie, and from some localities in western Ontario and in the Laurentian Mountains of Quebec. There is no doubt, therefore, that all over the area of *M. exalbescens* it is characterized by the hexaploid number 2n=42 chromosomes. Since the chromosome number is the same in both taxa, observational cytotaxonomy cannot contribute a more certain solution to their problem of classification than could morphology and chorology; in fact the occurrence of some reproductive barrier between *M. spicatum s. str.* and *M. exalbescens* can only be inferred as long as biosystematic experiments have not been performed including various populations of both. However, the present writer is of the opinion that these taxa may be biologically more effectively isolated than, e. g., *Populus tremula* and *P. tremuloides* and several other species pairs without differences in chromosome number, and thus favors their being retained at the species level until experiments prove this to be wrong.

The morphological differences between *M. spicatum* and *M. exalbescens* include many characteristics, but the most distinctive ones seem to be the following: (1) The number of pairs of leaf-divisions on each primary rachis is usually

14-24 in *M. spicatum*, but only 4-14 in *M. exalbescens*. (2) Winter buds are unknown from *M. spicatum*, whereas they are typical of *M. exalbescens*. (3) The floral bracts are rhombic to elongate in *M. spicatum* but typically spathulate-ovate or even oblong-cochleiform in *M. exalbescens*. (4) The female bracts in *M. spicatum* are longer than the fruits, but rarely equal the fruits in length in *M. exalbescens*. (5) The bracteoles are reniform or suborbicular in *M. spicatum*, but always ovate in *M. exalbescens*. (6) The bracteoles are broader than long in *M. spicatum*, whereas they are longer than broad or of equal dimensions in length and breadth in *M. exalbescens*. (7) The stem of the dried plant is usually fulvous or olivaceous in colour but rarely somewhat whitened in *M. spicatum*, whereas it always is distinctly whitened in *M. exalbescens*. The species also differ in several quantative characters, but since these seem to overlap, as such characters usually do, they are useful only when many measurements can be made and compared statistically. However, the differences between these two species are so obvious that even without knowledge of the occurrence of reproductive isolation between them, they can confidently be considered to be separate species. The differences are of a magnitude greater than that separating many good species delimited by classical taxonomists, and hundreds of species pairs with similar distribution but based on much weaker morphological characteristics could easily be listed.

In a paper reporting the results of a detailed study of populations in a New Jersey lake, Patten (1954) concluded that not only *M. exalbescens* but also *M. spicatum* must be met with in New Jersey. He was of the opinion that these species intergrade and should be regarded as races only of the same species. Unfortunately, no cytological studies have so far been performed on the material reported by Patten (l. c.) and the pollen fertility of the putative hybrids was not observed, nor was the fertility of the seeds, as far as the report goes. Based on the present knowledge of the differences between the parents Patten (l. c.) presumed were involved in the hybridization, some introgression could perhaps be expected if they happened to grow together at the same place.

One may perhaps venture to suppose that the results reported by Patten (l. c.) in fact do not support his assumption of the occurrence and introgression of *M. spicatum* in New Jersey, but that his presumed hybrids may rather have been formed between *M. exalbescens* and another more certainly North American species. Such a hybrid may or may not show some degree of fertility so that some introgression could be possible, although experimental studies are needed before it can be regarded as an acceptable solution of the problem pondered by Patten (l. c.). Such an assumption is, however, far more plausible and much less far fetched than is the hypothesis of the occurrence and introgression of *M. spicatum*, a species of another continent which is nowhere else even indicated from North America east of southwestern Alaska.

When Fernald (1919) distinguished *M. exalbescens* and excluded *M. spicatum* from North America, he also described another new species, *M. magdalense*, later (Fernald, 1924) corrected to *M. magdalenense*. This latter taxon is closely related to *M. exalbescens*, differing mainly in more or less dubious fruit characters. It is met with only on the Magdalene Islands and certainly belongs to the group of endemic races, from the regions adjacent to the Gulf of St. Lawrence, which have been unduly classified at a much too high level. The present writer is of the opinion that this taxon is quite comparable to the few local variations known in Europe from *M. spicatum* and so proposes that it be reduced to the level of variety: **M. exalbescens** var. **magdalenense** (Fern.) Löve, stat. nov. (based on *M. magdalense* Fernald, in Rhodora 21, 1919, p. 122, and *M. magdalenense* Fernald, in Rhodora 26, 1924, p. 198). Variations at the same level are expected to be discovered when detailed studies are made of other somewhat isolated populations elsewhere on the continent, as indicated already by Fernald (1919) in mentioning the occurrence in Colorado of specimens with elongate bracts, and, thus, in this character reminding one of *M. spicatum*.

The distribution area of *M. exalbescens*, according to Hultén (1947), includes the North American continent from

westernmost Alaska to Greenland, south to California, Arizona, New Mexico, Kansas, northern Indiana, and Connecticut. It seems to be replaced by *M. spicatum* in southwestern Alaska and the Aleutian Islands. It is likely that the species also occurs in easternmost Asia, though it is ignored by the authors of the Flora USSR and other recent Asiatic floras. In Greenland, the species is met with only in the west-central parts of the country, between Söndre Strömfjord and Umanak (cf. Böcher, Holmen & Jakobsen, 1957). There it belongs to a group of American plants of limited distribution the origin of which has not yet been properly settled (cf. Iversen, 1953; Böcher, 1954). — LABORATORY OF BIOSYSTEMATICS, BOTANICAL INSTITUTE, UNIVERSITY OF MONTREAL.

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BIDENS CONNATA VAR. GRACILIPES FERN. IN WESTERN MICHIGAN. — In a former article (Brittonia **11:** 190. 1959), I reported the occurrence of this interesting variety as growing on the east shore of Eagle Lake, Kalamazoo County, of southwestern Michigan. This location marked the farthest point west at which the variety was known to occur. It was originally described from Massachusetts, and subsequently cited by me (The Genus Bidens, Bot. Ser. Field Mus. Nat. Hist. **16:** 261. 1937) for "Maine and southward to Connecticut".

More recently I found a specimen of this same variety among additional materials sent me for examination from the Herbarium of the University of Michigan at Ann Arbor, *C. W. Bazuin 4282*, wet, sandy shore of Wolf Lake, 3-4 miles east of Muskegon, Michigan, Oct. 5, 1941. Wolf Lake is roughly seventy miles farther north and twenty miles farther west than the previously known habitat, Eagle Lake: in Kalamazoo County. To learn if the variety was still present and perhaps well established at Wolf Lake, I made a journey there on October 7th, 1960, visiting the southwest shore. Many specimens were observed growing in the wet sand almost immediately at the water's edge. Twenty or more plants were gathered for making dried herbarium specimens. These will be sent to various herbaria for record purposes in the course of time. — EARL EDWARD SHERFF.